DESCRIPTIVE.

Siemens & Halske Electric Company

OF AMERICA.

THE SIEMENS

BAND ARC LAMP.

GENERAL OFFICES & WORKS:

CHICAGO, ILLINOIS.

June, 1893.

THE SIEMENS BAND ARC LAMP.

This lamp is patented in the United States, patent No. 412,141; German Empire patent No. 42,900, and the following sizes are manufactured:

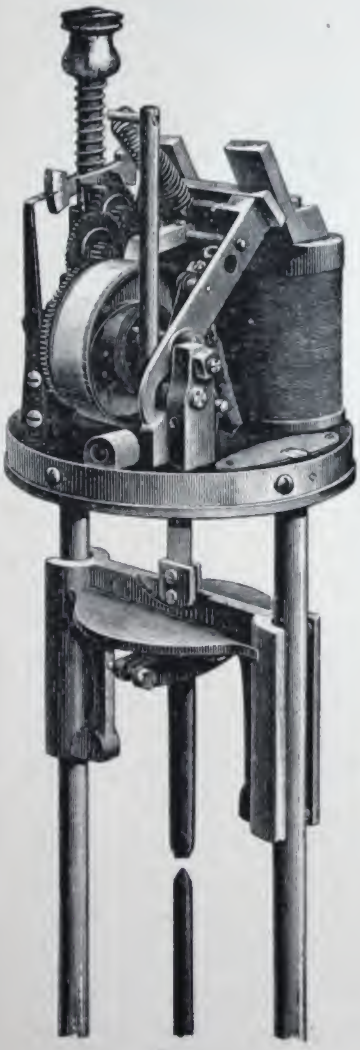

Fig. 1.

I. FOR CONTINUOUS CURRENT.

a. Smallest size band arc lamp, No. 5109, for currents of 1 to 3 amperes.

b. Medium size band arc lamp, No. 5110, for currents of 3 to 9 amperes.

c. Largest size, No. 5111, for currents of 10 to 35 amperes.

II. FOR ALTERNATING CURRENT.

a. Smallest size band arc lamp, No. 5115, for currents of 1.5 to 4.5 amperes.

b. Medium size band arc lamp, No. 5116, for currents of 3 to 16 amperes.

c. Largest size band arc lamp, No. 5117, for currents of 17 to 35 amperes.

The smallest size lamps, Nos. 5109 and 5115, are made in one length only, and will receive carbons with a maximum length of both equal to 15¾ inches.

The medium and largest lamps, Nos. 5110, 5111, 5116 and 5117 are made in three lengths; *i. e.* for carbons 15¾, 19¾ and 25½ inches total length.

III. Lamps with a Contrivance for a Fixed Focus with either Continuous or Alternating Current.

a. Smallest size band arc lamp is not made.

b. Medium size, No. $\frac{5110}{5119}$ or No. $\frac{5116}{5119}$

c. Largest size, No. $\frac{5111}{5120}$ or No. $\frac{5117}{5120}$

The rating of a lamp is given best in amperes, as the light falling at different angles to a horizontal plane varies greatly in candle power. A rating in candle power, therefore, depends entirely upon the angle at which the light is measured.

With a continuous current, the light is generally deflected downward, and its greatest power is projected at an angle of 40 degrees (with the horizontal plane).

With the alternating current but little light is thrown in a horizontal direction, while quite as much is thrown at an angle in an upward as in a downward direction. For this light, the use of a reflector is therefore recommended.

We may estimate the candle power per ampere for lamps of medium power:

With a continuous current at 200 candle power;

With an alternating current at 120 candle power.

The average tension required at the arc will be:

With continuous current 40 volts;

With alternating current 30 volts.

Our smallest band arc lamp, No. 5109, with a current of 1 ampere and including the necessary regulating resistance, consumes the same energy, and has about double the candle power of a sixteen candle incandescent lamp. With 1.5 to 2 amperes this lamp is very useful for many purposes.

In order to produce a steady light from an alternating current arc lamp, it is necessary that the rate of alternation of the current shall not be lower than a certain limit. For lamps of any design, this limit is 50 complete periods per second, which corresponds to 6000 alternations of poles per minute. Below this number the alternating current will always furnish a flickering light, no matter what the mechanism of the lamp may be.

The band arc lamp is a shunt lamp which has no electro magnet in the main circuit, a feature which distinguishes it from older styles of shunt lamps. The lamp can be arranged for any desired strength of current by following the rules given below.

The name of Band Lamp is derived from the band of copper which carries the holder of the upper carbon, and conducts the current. The construction of the lamp is based on the following principles:

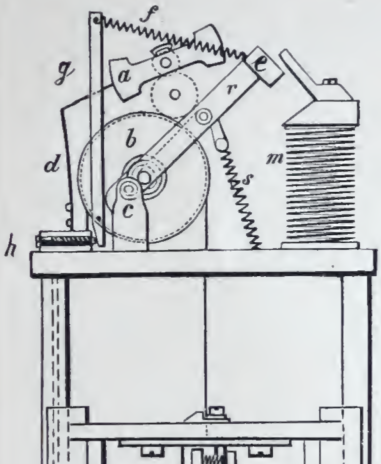

Fig. 2.

An inclined frame turns on pins at "*c*" and supports the drum "*b*" around which the copper band is wound. This frame also supports the pinion wheels with the *escapement*, and at the upper end of the frame, the cross piece "*e*," which is the iron armature.

The attraction of the shunt electro magnet "*m*" and the weight of the upper carbon and holder draw the frame "*r*" downward, while the spring "*f*" pulls in the opposite direction. The unwinding of the copper band causes the drumb "*b*" and the pinion wheels to revolve, while the escapement with its balance lever "*a*" oscillates rapidly.

When the frame "*r*" is near its highest position, a tongue piece projecting from the lever "*a*" strikes the stop "*g*," and the motion of the clockwork ceases. By turning the frame downwards, the escapement is released, and the copper band is gradually unwound from the drum, while the upper carbon holder sinks slowly by its gravity.

The lamp operates as follows: When the current is turned on, the frame is drawn downward by the strong attraction of the shunt electro-magnet, into its lowest position; the copper band is

unwound until the upper carbon touches the lower one. The current will then flow through the carbons instead of through the shunt, and the electro-magnet therefore loses its current. The spring "*f*," having an excess of power, draws the frame up again and forms the arc between the carbons. As the carbons are consumed at the points, and the arc grows longer, the current in the shunt magnet is increased gradually, and the frame is drawn down to a position which it will retain permanently. The slightest change in the length of the arc will start the escapement, and this will cause the lamp to feed at regular intervals of time.

Among other details of the working parts of the lamp, which serve to make it burn quietly and evenly, may be mentioned: The dash-pot to check a too rapid motion of the frame; a contrivance which makes up for loss of weight caused by the burning of the upper carbon; and the peculiar shape of the pole shoes and armature.

The mechanism described is fastened to a cast iron plate, and has above it a cast iron cover, in which the terminals are placed. The negative terminal is insulated from the cover, and may be distinguished by a small porcelain sleeve through which it passes.

On lamps with variable focus, the lower cross piece serves as a carbon holder; a cup and ball joint carries the clamp for the lower carbon. The arc descends gradually as the lower carbon is consumed.

On lamps with a fixed focus, the lower carbon holder is coupled to the upper carbon holder by means of two chains running on small upper and lower pulleys. Both carbon holders are thus compelled to move together in opposite directions. These chains and pulleys are inside of tubes which carry the lower cross piece. These lamps are used for a similar purpose to the lamps with variable focus.

The carbon clamps are adjustable. Carbons of different diameters can be held by them, and they can be properly centered by means of the lower holder. Band arc lamps are well adapted to be operated in multiple. For a continuous current and the usual working tension of 65 volts, each lamp must be placed on a separate circuit. With 110 volts two can be connected in series. For alternating current and 100 volts, three band arc lamps can be arranged in series, as each one requires a tension of only 30 volts.

To make lamps BURN WELL if connected in parallel, a regulating resistance must be placed in the circuit of each group, which will consume a certain part of the voltage. The amount of resistance is determined in the following manner:

Multiply the voltage of each lamp (see table) by the number of lamps in a group; subtract the product from the total voltage of the current. The remainder divided by the amount of current per lamp (amperes) gives us the resistance in ohms. For example: with two lamps of 9 amperes, placed in series on 110 volts, each lamp requiring an electro motive force of 40 volts at the terminals, we figure as follows:

$$2 \times 40 = 80$$
$$110 - 80 = 30$$
$$30 \div 9 = 3.33 \text{ ohms.}$$

It makes no difference whether this resistance is placed before, behind or between the lamps. If the feeders themselves offer considerable resistance, its amount must be determined and deducted from the amount of regulating resistance. By using iron wire in the feeders, all the required resistance may often be obtained, and the use of a regulating resistance dispensed with.

We append some more examples, showing how to calculate the amount of resistance:

A lamp of 35 amperes requires about 45 volts electro motive force at the terminals; hence we have, if burning on a circuit of 65 volts:

$$R = \frac{65 - 45}{35} = 0.571 \text{ ohms.}$$

120 volts, two 12 ampere lamps in series (each 41 volts).

$$R = \frac{120 - (2 \times 41)}{12} = 3.17 \text{ ohms.}$$

100 volt alternating current, three 10 ampere lamps (30 volts each).

$$R = \frac{100 - (3 \times 30)}{10} = 1.0 \text{ ohm.}$$

If so ordered, the medium and largest band lamp for continuous current, No. 5110 and 5111, will be furnished with a short circuiting apparatus, so that if one lamp gets out of order it will not extinguish all the rest. This contrivance is a combination of two electro magnets, which keeps the terminals of the lamp short circuited so long as the

current cannot pass through the carbons; at the instant the carbons touch, the short circuit ceases.

Lamps provided with this device are to be used only on circuits where there is no danger that the current can increase in strength sufficiently to injure the lamps, even though several of them should be extinguished.

CARE OF LAMPS.

The quality of light of the band lamp depends mainly on the carbons and the cleanliness of its various parts. Handle the lamps by the solid parts only, and carry them in an upright position. Clean the lamp with a dusting brush after inserting the carbons. The upper carbon holders must not be pushed up too rapidly, as is often done, but should be raised gradually so that the copper band may remain taut.

In handling the lamps with fixed focus, use slight pressure in pushing down the lower carbon holder. In extracting remnants of carbons, hold the carbon holders firmly, so that the clockwork will not start. New carbons must be centered with the greatest care, for which purpose the cup and ball joint of the lower carbon holder is provided. Pull the upper carbon down until it touches the lower one.

In working with continuous current, have special care to prevent reversal of poles, because it might result in the destruction of the lower carbon holder in consequence of a too rapid combustion of the positive carbon. An interchange of poles is readily discovered by the illumination of the glass globe and by the shape which the carbons assume. If the poles are right, both carbons will burn equally fast, and the upper (positive) will have a concave shape, while the lower carbon (negative) will be pointed. Consequently, the upper part of the globe will be rather dark and the lower part strongly illuminated, the two parts being separated by a distinct line.

To arrange a lamp for different voltage: First, adjust the holders for the new carbons, which can be done easily with a screw driver. Move the clamps in such a way that the center of the new carbons will be correctly aligned. Then adjust the lamp for the new voltage (see

table). Turning the screw "*h*" will affect this. This screw is shown in Figs. 3 to 8 in front part of the cover, to the right of the center line and a little above one of the fastening screws. Turning the screw "*h*" to the right increases the size of the arc and the tension, while a turn to the left decreases both. The mistake is usually made of turning the screw too far; it should only be about $\frac{1}{20}$ of a full turn at a time. After every such slight turn, wait for the lamp (which must not be subject to vibration) to adjust itself. Just before the escapement is released, the voltage must be at the highest, and just after it stops, the voltage will be lowest. This lowest voltage is the one given in the table. Continue experimenting with the screw until the tension desired has been obtained. The regulating resistance must of course be adjusted to the new voltage and current.

Select the carbons according to the subjoined tables. Their diameters are fixed by strength of current, and the length by the time they are intended to burn. The upper and lower carbons must always have equal length.

A. DIRECT CURRENT.

Current in Amperes		1	1.5	2	3	4.5	6	9	12	15	20	35
Tension in Volts		32	33	34	36	37	38	40	41	43	44	45
Diam. in Millimeters, upper carbon (cored)		6	8	9	11	13	16	18	20	20	22	25
" " " lower carbon (solid)		4	5	6	7	8	10	12	13	13	14	18
Time of burning in hours, if the length of each carbon is in inches.	8 in.	6	7.5	7.5	8.5	10	10	10	10	10	10	10
	10 in.				11	13	13	13	13	13	13	13
	12¾ in.				15	18	18	18	18	18	18	18

B. ALTERNATING CURRENT.

Current in amperes		2	3	4.5	6	9	12	15	20	35
Tension in Volts			30	30	30	30	30	30	32	34
Diameter in Millimeters, both carbons (alternating current carbon).			7	8	9	10	12	14	16	20
Time of burning in hours, if the length of each carbon is in inches.	8 in.		7	7	7	7	7	9	9	9
	10 in.		9	9	9	9	9	12	12	12
	12¾ in.		12.5	12.5	12.5	12.5	12.5	16	16	16

Give the number of alternations when ordering alternating current arc lamps.

5111.
18 St.

5111.
14 St.

5111.
10 St.

5110.
10 St.

5110.
14 St.

5110.
18 St.

Fig. 3—8.